

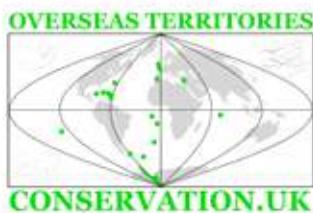
Wonderful Water

An Environmental Education Programme

A Watery World

Wetland Ecosystems in the
Turks and Caicos Islands - Part 1

Teachers' Guide



TCI
Education Department



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Target Age Group - 9-11 years

This environmental education programme has been produced by the UK Overseas Territories Conservation Forum (UKOTCF) and the Turks and Caicos Department of Education.

It was part-funded by the Overseas Territories Environment Programme (OTEP) of the UK Department for International Development and the Foreign and Commonwealth Office.

The project was developed from an original idea by Mr Edgar Howell, Director of Education, Turks and Caicos Islands, and these materials developed by a team co-ordinated by Ann Pienkowski, Environmental Education Co-ordinator, UKOTCF. It is hoped that through the teaching materials developed for this project, students in TCI will gain a greater understanding of the importance of the water ecosystems in TCI, and the need to conserve these.

As a possible model to assist environmental education in other areas of the Caribbean (especially UK Overseas Territories) these materials will be made available to a wider audience.

Contents

Introduction	4
Background information on Ecosystems	6
Tides	7
A lesson about tides	9
Worksheet - What Causes the Tides?	10
Activity suggestions to support pupil learning	12
1. Assessing initial knowledge.	12
2. Introduction to TCI Wetlands	12
3. Match animals and plants to a wetland habitat	12
4. Field Trip	12
5. Create an Ecosystem in a bottle or jar	14
6. Investigate the importance of freshwater.	15
7. Produce artwork (paint, collage, drawing, etc) to demonstrate a TCI wetland ecosystem. Use the given example of a terrestrial ecosystem as a model.	15
8. Write Acrostic Poems about Wetland Ecosystems.	15
9. Learn Key vocabulary through wordsearch and other word puzzle activities.	15
10. Demonstrate understanding through comprehension exercise (see comprehension worksheet).	15
11. Create a poster and / or report (written or oral) to explain the importance of wetlands.	15
Worksheet - understanding wetland ecosystems	16

Introduction

In devising these teaching materials, reference was made to the TCI Science Curriculum for Grade 5 and 6, and the science teaching materials currently being used in primary schools in TCI.

To help teachers review their students' progress, expected levels of achievement for a particular stage in a students' education have been developed into statements of competency. These are summarised below. The objectives given in the pupils' materials relate to these statements of competency.

Assessment criteria / Statements of competency

These level statements relate to levels of attainment given in the Science National Curriculum for England, but are compatible with such statements about expected attainment in many other curricular.

This table gives the level an average child is expected to achieve at a particular stage in their schooling:

End of grade:	Expected attainment related to curriculum levels (from National Curriculum for England)		
	Slower progress	Most pupils	Faster progress
4	L2	L3	L3/4
5	L2/3	L3/4	L4/5
6	L3	L4	L5

The assessment criteria / statements of competency, which relate to the unit: *Wetland Ecosystems in the Turks and Caicos Islands* are given below.

L2: Match animals and plants to a wetland ecosystem using pictures or photographs.

L3: Know that a healthy ecosystem is balanced (enough food and water for the plants and animals to live and reproduce successfully)

L4: Know that an ecosystem is a community of living things that sustains itself.

L5: Recognise that a healthy ecosystem supports a wide variety of plants and animals, not just large numbers of individuals (biodiversity).

The pupils' text provides key information for pupils.

The teachers' guide contains further information and resources for teachers, suggested activities for pupils, and example pupil worksheets. Practical activities and suggestions for places to visit are also included.

The suggested pupil activities and worksheets can be carried out by individuals, pairs or small groups.

Any comments, suggestions or queries should be sent to the UKOTCF Environmental Education Co-ordinator, Ann Pienkowski. Email: apienkowski@ukotcf.org

Background information on Ecosystems

What is an ecosystem?

Studying and learning about ecosystems can be a vast and confusing topic for pupils. The word ecosystem can be intimidating, and children may find it hard to understand the basic concept of how ecosystems work. Ecosystem is short for “ecological systems”. Eco comes from a Greek word (oikos) meaning house or surroundings. It has come to mean “living things”. Ecology is the branch of biology that studies the interrelationship between organisms and their environment. Simply put, an ecosystem is all the animals and other living things in a specific area, along with the non-living things. An ecosystem is a complex set of relationships between all the components of an area. It includes plants, trees, animals, fish, birds, micro-organisms, sun, weather, atmosphere, water, soil and people.

Ecosystems vary greatly in size and the elements that make them up, but each is a functioning unit of nature. Everything that lives in an ecosystem is dependent on the other species and elements that are also part of that ecological community. If one part of an ecosystem is damaged or disappears, it has an impact on everything else.

When an ecosystem is healthy, scientists say it is sustainable. This means that all the elements live in balance and are capable of reproducing themselves. There is usually biodiversity, meaning that there are a variety of living organisms and species in that environment.

An ecosystem can be as small as a puddle or as large as the Atlantic Ocean. The ocean ecosystem includes every living and non-living thing in the area, so the ocean is in fact several smaller ecosystems interacting with each other. This is why the idea of an ecosystem can be quite difficult to grasp. As far as the boundaries of an ecosystem go, it depends upon how you use the term. You could have an entire ecosystem underneath a big rock. On the other hand, you could be talking about the overall ecosystem of the entire planet, which is termed biosphere.

Different ecosystems are not generally isolated totally from each other. However, each is largely self-contained so that it provides a practical unit for study or management.

Tides

What are tides?

Tide is the rhythmic rising and falling of the surface of the seas.

As the tides rise and fall, they create flood and ebb currents. As the tide rises, water moves toward the shore. This is called a flood current. As the tide recedes, the waters move away from the shore. This is called an ebb current.

When the sea level is highest, high water (sometimes called high tide) occurs. Low water corresponds to the lowest sea level. The difference in height between the high tide and the low tide is called the tidal range. In the Turks and Caicos Islands the tidal range is quite low, about 1 metre. In some other parts of the world it can be more than 10 metres. In the Bay of Fundy in Canada, the tidal range can be as much as 15 metres. These differences are caused mainly by the shapes of the coasts.

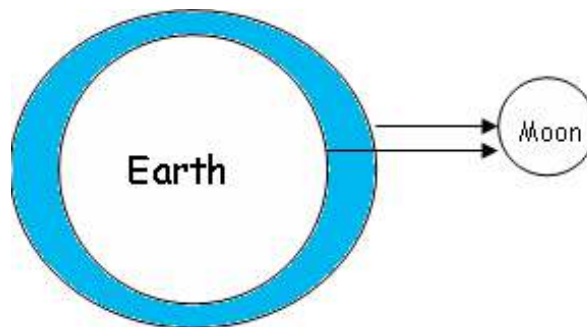
The part of the shore between the high-tide line and the low-tide line is the intertidal zone. Here live plants and animals adapted to survive both on land and underwater. Shellfish, seaweed, crabs and worms live in the intertidal zone.

What causes tides?

It is all to do with the planets - The moon has a 'pull' effect on the oceans. The correct name for this pull force is gravity. So as the moon circles the earth (about twice per month), the oceans' water levels go up and down. The sun also has an effect: when in line with the moon it can cause very high tides. If there are bad storms at the same time, you can get severe floods.

The moon is the body in space closest to the earth and it exerts a strong gravitational pull. This gravitational force pulls the water in the oceans towards the moon. But at the same time the earth itself is affected by the moon's gravity, so the earth is "pulled away" from the water on the opposite site from the moon. The effect of gravity of the moon changes with distance, so the solid earth is pulled towards the moon more than the water on the far side. This means that when it is high tide on one side it is high tide on the other as well.

So you get a bulge in the water on the near side because it is pulled harder than the solid earth, and you get a bulge on the far side because the solid earth is pulled harder than the water on that far side.

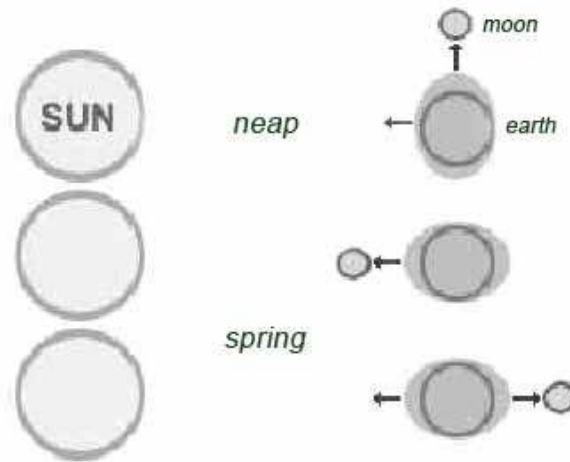


A animated video demonstrating this can be viewed at the website given below.

<http://glencoe.mcgraw-hill.com/sites/dl/free/0078778069/160350/00076708.html>

When the sun, moon and earth are in line with each other, which happens about every 14 days at full moon and new moon, they cause higher waters and lower waters than usual, called spring tides. This is because the sun adds its gravitational pull to that of the moon.

When the sun and moon are at right angles to each other, during the first and last quarter of the moon, they pull in different directions and cause the least difference between high and low tides. These are called neap tides.



Sometimes, because the moon's orbit is not completely even, the moon is closer to the earth than usual. When this happens during new moon, when the moon is between the earth and the sun, there is an unusually high tide, called the proxigean spring tide.

In 24 hours the earth rotates a full 360 degrees. In the same period of time the moon rotates 12 degrees around the earth. This means that wherever you are on the coast there will be a high tide approximately every 12 hours 25 minutes.

Tide-like effects of weather

The level of water on the coast can be affected by variations in air pressure and by high winds. In places with a high tidal range, these weather effects are secondary. In places like TCI, where the tide range is low, weather effects on sea-water levels can be proportionately much higher, especially in tropical storms. Weather effects are, of course, much less predictable than tides.

A lesson about tides

If the opportunity occurs, take your pupils to the beach at high and low tide so that they can see the difference.

Objectives

- explain how the moon and the sun influence the height and frequency of the ocean's tides
- explain the difference between neap tides and spring tides

Resources

Demonstration materials: balls, rubber bands, fixed sticks.

What causes the Tides? Question sheet.

Lesson plan

Introduction

Provide students with a general overview of tides and lunar cycles, based on the information given above.

Practical Demonstration

It is quite difficult to demonstrate this, but worth trying as the causes of tides are quite complex. One way is to use a rubber band (for the ocean) around a ball (for the earth). Pulling on the rubber band will show how the "bulge of water" is formed by the force of gravity on one side. To demonstrate the bulge on the opposite side, keep one side of the rubber band still (for example by putting it over a fixed stick), and as the rubber band is pulled from one side, move the ball forward a little. You may well have other ideas, and you can also ask your students to think about how they would demonstrate it to younger children!

Ask students to complete Worksheet – What causes the tides (see below)

Conclusion

Review students' responses to the Question sheet, and clear up any misunderstandings.

Discuss why it might be important for people to know whether the tides will be high or low at specific times.

Explain that tide tables are produced to let people work out the times of high and low tides. DECR should be able to help with information about tide times in TCI.

You can also get tidal information from the web, eg

<http://www.tide-forecast.com/locations/HawksNestAnchorage-TurksIslands/tides/latest>

Worksheet - What Causes the Tides?

Name _____

Date _____

What Causes the Tides? Questions

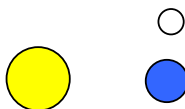
A. What do you know about tides?

1. What kind of tide would you get from this line-up of sun, earth and moon?



- 1.a. Can you explain, in your own words, how the tide is caused.

2. What kind of tide would you get from this line-up of sun, earth and moon?



- 2.a. Can you explain, in your own words, how the tide is caused.

B. True or false?

Can you answer these questions without looking at the reading?

1. Neap tides are caused when the sun and moon pull from opposite directions. T/F
2. The earth rotates 360 degrees in 24 hours. T/F
3. Tides are caused by the gravitational force of the moon. T/F
4. The sun has nothing to do with the tides. T/F
5. A proxigean spring tide only happens when the moon is full. T/F

What Causes the Tides? Answers

Activity A.

1. Spring tide.

1.a. The children should give the following information in their own words:

The sun, moon and earth are in line with each other, which happens about every 14 days at full moon and new moon, causing higher and lower tides than usual, called **spring tides**, because the sun adds its gravitational pull to that of the moon

2. Neap tide.

2.a. The children should give the following information in their own words:

The sun and moon are at right angles to each other during the first and last quarter of the moon and they pull in different directions which causes the least difference between high and low tides.

Activity B.

1. False

2. True

3. True

4. False

5. False

A Watery World

An Introduction to Wetland Ecosystems in TCI

Activity suggestions to support pupil learning

These activities can be carried out by individuals, pairs or small groups.

The order in which the activities are given here does not mean that they should be carried out in this order.

1. Assessing initial knowledge.

Conduct an introductory discussion to find out what children know about ecosystems. Their responses can be recorded on a class flip chart. After teaching the unit, this exercise can be repeated, and the “before” and “after” flip charts compared.

2. Introduction to TCI Wetlands

Use the prepared Powerpoint presentation of TCI wetland sites. Followed up with discussion. Have any of them visited any of these places? What were their feelings about them? Etc.

3. Match animals and plants to a wetland habitat

Use the animal and plant pictures provided to say which ones are likely to be found in a wetland, and which ones not.

4. Field Trip

Try to arrange a field trip to a wetland ecosystem. Because the water conditions in TCI vary so much with the season and the amount of recent rain, it is important for teachers to check out a site before taking students. This not only gives an idea of what might be of interest for the students, but will enable the teacher to assess any safety or access issues.

Any animals collected for observation, either for observation during the field trip, or to take back to the classroom for observation, must be released back to their original site when the observations are completed.

Before visiting sites, students need to be prepared about the appropriate way to behaviour around wildlife. They should be instructed:

- to walk, not run
- to speak very quietly
- avoid scaring animals - don't approach too closely.

This is common sense, but is not obvious to all students.

Teachers will very likely know suitable sites to take their students to.

The suggestions below have been provided by Bryan Naqqi Manco, who at time of writing is a conservation officer with DECR. DECR can be contacted for further information and suggestions. The Turks and Caicos National Trust also manage important wetland sites, and can be contacted for further advice and information.

Grand Turk:

There are a variety of wetland sites on Grand Turk which are fairly accessible and worth visiting. The salinas provide great places to visit, and many are right by the road. North Wells and South Wells are freshwater wetlands. North Wells can accommodate quite large groups. North and South Creek offer different wetland ecosystems, including beach and mangroves.

Salt Cay:

The salinas are easy to visit. The Creek Area and the Pool by the Cemetary offer different types of wetland to look at.

South Caicos:

Along the dirt road called "Back Road" that connects the south-east salinas along East Bay to Bell Sound Road, there are a few small buttonwood ponds that are fresh but usually just mud in the dry season. They have the TCI / Inagua endemic Nash's pepperwort fern *Marsilea nashii*. There's another good brackish pond in Bell Sound Subdivision. The Salinas near Boiling Hole also usually have lots of birds.

Middle Caicos:

Village pond, near Conch Bar. Conch Bar Caves contain wetland ecosystems. Garden Pond, between Bambarra and Lorimers, is a Turks and Caicos National Trust site and is at the end of a short field road. Contact the TCNT about visiting this site. The Fish Ponds, between Conch Bar and the Causeway, contain much more wildlife, including birds, now that the under-road pipes are installed.

North Caicos:

Cottage Pond is a freshwater sinkhole, and deep, so care needs to be taken. It is preferable to limit group size to less than 30 for this site. Tattyland Down Pond does not always have water, but usually has good plant and bird life. It is a good example of a *palustrine* habitat with marsh and swamp parts. [NB *Palustrine* comes from the Latin word *palus* or marsh. Wetlands within this category include inland marshes and swamps as well as bogs. *Palustrine* systems include any inland wetland which lacks flowing water, contains ocean-derived salts in concentrations of less than 0.05%, and is non-tidal.]

The ponds near 3 Mary Cays (Moore Hall and Mud Hole) can be interesting.

Flamingo Pond is worth looking at, even at a distance from the viewing platforms (see if you can take some binoculars with you - you may be able to borrow some from DECR or the TCNT).

The borrow pits along the Toby Rock Road, although man-made, often have birds and have a lot of plant life. Also the ponds dug at the end of the Ready Money road usually have some bird life around them, and almost always have fish.

Providenciales:

Although man-made, and in a very altered environment, the ponds on the golf course are worth a visit, but do contact the golf club first.

There are some brackish ponds near Sunshine Nursery. Contact the Nursery owner if you wish to make a visit here.

Pigeon Pond / Frenchman's Creek are very important saline wetlands.

Wheeland Ponds are another good place to visit.

Field Trip Activities

Some suggestions for activities before, during and after the field trip.

Before

Introduce the site to be visited to the children. Characteristics of the wetland (eg saline, brackish, freshwater); demonstrate with maps, photos, discuss what they might see. Some students may know the site, and can report what they already know.

At the site

Use digital cameras, hand lenses, sketching, mapping, to record different plants and animals seen. Write descriptive notes of the site, the plants and animals (especially those not known). Make a sound map. Ask children to sit very quietly and note the sounds they hear and which direction they come from over a set time (eg 5 minutes). Ask children to note what they like / dislike about the site.

A field trip can also be used as an opportunity to create an ecosystem in a jar (see below).

After the visit

Oral and written reports

Painting

Drawing

Discussion

5. Create an Ecosystem in a bottle or jar

This personal account of making an ecosystem in a bottle comes from Bryan Naqqi Manco.

"This is a great activity. I was introduced to it during a nature camp and used to do it all the time. I had one going for 7 years and had to "release" it when we moved house. These are super-easy to do with freshwater. The key is finding a real freshwater (not brackish) source pond like Garden Pond. Have each student bring in a plastic peanut-butter jar (glass is ok for older students) and you have each kid fill the jar halfway with water and mud from the pond, also small dead leaves, twigs, etc then fill the rest of the way up with rainwater (no treated water)."

Transport the jars in a cooler with a small ice pack to be sure they do not get boiled in the sun. Then sit them in the light, but where they will not get too hot, and watch what shows up. There should be loads of micro-organisms zooming all over the place in there: daphnia, cyclops, insect larvae, diving beetles, nematodes. A hand lens is very useful. An eyedropper can capture little water creatures for transfer to a clear petri dish which can then be put on an overhead projector (do not let the water heat up though!).

I used to open my jar from time to time and poke the mud with a chopstick to let out the gas bubbles, scrape algae from the sides, sometimes add water, but mostly just kept it closed. As long as there are algae growing, there will be other creatures too.

Another fun option for this might be to harvest mud from dry pine yard ponds or saline ponds then drop it into a gallon pickle jar of rainwater. You might get brine shrimp or even sheepshead minnow hatchlings from the egg bank in the mud.

Most of the little critters in those ponds are used to awful water quality and will take a lot of abuse; they'll mostly also produce eggs that will hatch when water quality improves too.

6. Investigate the importance of freshwater.

Place a small bath or bowl in a quiet corner of the school yard and/ or encourage children to place a bowl of water in their home yard. Make observations about what happens eg does water get algal growth, do mosquitoes invade (if and when they do, throw the water away - you do not want to breed mosquitoes!), do birds or other animals visit?

Ask children to keep diary notes of what happens to their bowl of water.

7. Produce artwork (paint, collage, drawing, etc) to demonstrate a TCI wetland ecosystem. Use the given example of a terrestrial ecosystem as a model.

8. Write Acrostic Poems about Wetland Ecosystems

(eg for the word Wetlands:

Wonderful

Ecosystem

T.....

9. Learn Key vocabulary through wordsearch and other word puzzle activities.

(There are lots of online wordsearch generators - eg

<https://www.superteacherworksheets.com/generator-word-search.html>)

10. Demonstrate understanding through comprehension exercise (see comprehension worksheet).

11. Create a poster and / or report (written or oral) to explain the importance of wetlands.

Worksheet - understanding wetland ecosystems

Comprehension exercise based on Pupils' Text

What have you discovered about Wetland Ecosystems in TCI?

Answer these questions, in complete sentences if you can. Use the information about the different wetland ecosystems to help you.

1. Name a bird which you can find on a salina.
2. Which plant provides a safe place for young fish to grow?
3. Which endangered duck needs swampy areas in TCI?
4. Why are the small animals which live in mud important?
5. Why are TCI wetlands important for the TCI economy?
6. What sort of activities do you think an Ecotourist would want to do and why?
7. Write your own sentence about something else you know about wetlands.